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Modelling Students' Mood and Rate of Comprehension Abilities in Teaching Simulator based on Problem-based Learning Model and Big Five Personality

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Abstract

Teaching Simulator is a role-playing game application where the user acts as a teacher who teaches in a virtual class. To develop a dynamic teaching simulator, which the teachers can interact with virtual students through actions chosen by the teacher from static action assets provided by the system based on the preference of the lesson plan, modelling student's mood and behaviors as well as cognitive and affective abilities achieved by virtual students need to be done to produce a learning simulation that mimics the actual learning process and achievement. The purpose of this study is to propose a model of students' cognitive and affective ability rate in a teaching simulator whose learning activities follow the stages of the problem-based learning model. Modelling is constructed by analyzing case study data on the influence of big five students 'personalities on students' self-perception of their understanding and interest during the learning process conducted to 34 vocational school students. The modelling constructed was implemented to game teaching based on Problem-based Learning Model and Big Five Personality. Based on this research, it is obtained that conscientiousness is related to students 'understanding, so it is defined as an independent variable in the model of students' cognitive rate. In addition, extraversion and neuroticism are defined as independent variables in the affective ability rate of students.

CCS Concepts: • Teaching Simulator • Modelling Student's.

Keywords: Modelling student's mood, teaching simulator, problem-based learning

1. Introduction

Modelling students' mood and comprehension abilities are the component parts that play an important role in the development of teaching simulators. Teaching skills as one of the teacher pedagogical competencies must be understood in developing learning. Education students need training and teaching exercises that must be facilitated. The complexity of the process of teaching and learning activities makes the theme of development of learning support process tools to prepare the profession of educators and educators" as one way to overcome the problem of pedagogic competence. One of the software that already exists today is Teaching Simulator. Teaching Simulator is a game application where the teacher will be in a virtual class where the teacher can interact with virtual students, be able to make their own decisions, and receive feedback from their actions by

the system as well as to achieve cognitive and affective abilities of students. These things are done so that they can resemble the conditions in a real classroom so that after the teacher completes the simulation the teacher is ready to teach in a real classroom [1].

Chieu and Herbst [1] developed a Teaching Simulator that applied artificial intelligence techniques to design learning environments. With the decision-making models and resources used in teaching simulators, teachers can improve teaching practice. Fatimah et al. [2] developed a Teaching Simulator equipped with animated movies, an application role playing game where the user acts as a teacher who will prepare and implement a classroom learning with various characteristics of students. Some real instructional videos available in Teaching Simulator can be used as guidance and comparison in the learning process, so that users can practice more directed to improve pedagogic competence.

For further improvement of the pedagogic competence of teachers in terms of mastery of the class, especially in taking action in dealing with student attitudes during the learning activities but by keeping in line with the lesson plans that have been made at the beginning of the game, it is necessary to develop the modelling of the students. This will be done by developing a dynamic game-based teaching simulator where a user can engage in the teaching and learning process through a virtual classroom with varied characters of students. One way for virtual students to have various personalities similar to real students is to use the big five personality (personality trait) method and combined with artificial intelligence (AI) to model the behavior of these virtual students.

In various behavioral and psychological studies, the Big Five Personality Model is widely used as a reference [3]. Numerous researchers are also investigating the relationship between The Big Five personality traits and student academic achievement. Furnham, Dissou, Sloan, & Chamorro-Premuzic [4] stated that personality affects cognitive abilities varies by five to ten percent. Starting from the finding Costa & McCrae [5] which states that academic achievement can be predicted by personality traits, more specifically, Wagerman and Funder [6] found that conscientiousness acts as a predictor of academic performance. Furthermore, Babakhani [7] in his case study found that the four aspects of the personality trait, namely conscientiousness, openness to experience, extraversion, and agreeableness, were directly related to academic achievement.

2 METHODS

2.1 Participant and Learning Model

The subject of this study was a class in a vocational school in Bandung, which consists of 34 students that divides students into 5 groups, while the object itself were students' personalities and the process of online teaching and learning activities using zoom video conference. The main learning stages a problem-based learning [8] with the following stages: (1) introduction and apperception, (2) Meet the Problem, (3) Know/Need to Know, (4) Define the Problem Statement, (5) Gather Information, (6) Share Information, (7) Generate Possible Solution, (8) Determine Best Fit Solution, (9) Present the Solution, (10) Debrief the Problem, and (11) Closing. During learning, students were asked to turn on the camera so that their activity and mood can be observed. However, during the learning process one student turned off the camera, so he was not included in the research sample.

2.2 Measurement and Procedures

2.2.1 Student's personality. To find out student's personality, they were asked to fill out a questionnaire using A 10-item short version of the Big Five Inventory developed by Rammstedt and John [9], which were conscientiousness, openness to experience, extraversion, neuroticism and agreeableness. Question instruments that have been validated in English and German were translated into Indonesian. Furthermore, the instrument was validated by linguists and psychologists to match the criteria for the Indonesian language students around 15 to 17 years.

2.2.2 Student's Self-Perception. To measure the level of cognitive and affection of students, the students were asked to fill out a questionnaire in the form of self-perception related to their experiences during the learning about their understanding and interests which was validated by educational experts. Cognitive level is represented by student perception on their understanding to the material [10] while affection level is represented by student perception on their interest and engagement in the process of learning [11].

2.2.3 Student's Mood and Actions. When learning was taking place, the students' mood, activity, and attitude were observed by five observers. After the whole learning activity was completed, students were asked to collect the results of their work and screenshots of their notes to the observer to validate their learning experiences and activities.

3 Results And Discussion

3.1 Data Analysis

The following were the findings we obtained after analyzing the research data. From 33 students, on a scale of 5, the mean value of each personality was presented in Table 1.

Table 1. Student's personalities

	N	Min	Max	Mean	Std. Dev
P1	33	2.0	5.0	3.42	.76
P2	33	1.5	3.5	2.38	.46
P3	33	1.5	4.5	3.35	.78
P4	33	1.5	5.0	3.03	.81
P5	33	1.0	5.0	3.18	.99
Valid	33				

Student's personalities: (P1) Extraversion, (P2) Openness to experience, (P3) Conscientiousness, (P4) Neuroticism and (P5) Agreeableness.

Table 1 illustrated that based on the average and standard deviation of the personality level, the students have various the personality levels. However, based on the mean, the level of each student's personality is at a moderate level. It is considered that personality traits are a stable personal characteristic [12] then the sample is suitable to be an object research.

Based on the results of filling out the questionnaire by the students, the average level of understanding and interest of the students in each learning stage was as follows: (S1) Meet the Problem, (S2) Know/Need to Know, (S3) Define the Problem Statement, (S4) Gather Information, (S5) Share Information and Generate Possible Solution, (S6) Determine Best Fit Solution, (S7) Present the Solution, (S8) Debrief the Problem illustrated in Fig. 1 and 2.

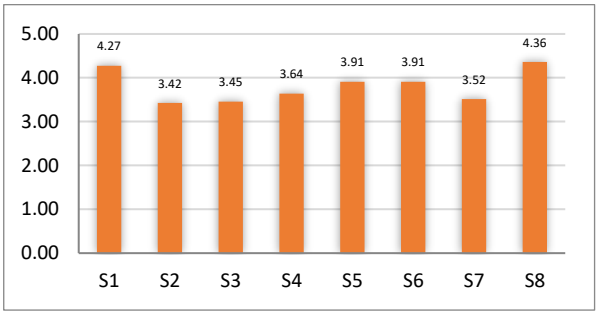

Fig. 1. Student's Self-Perception in their understanding of the material

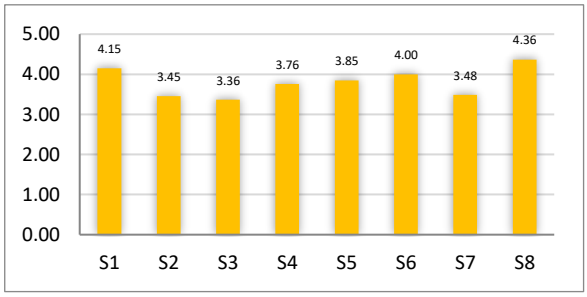

Fig. 2. Student's Self-Perception in their interest in the process of teaching and learning

Overall, based on Fig. 1 and 2, it can be seen that both students' understanding and interest have higher scores when the stage of meet the problem and the brief the solution or when the teacher get hold of class activities. This is in accordance with Bernard and Senjawati [13] about student understanding will be obtained more quickly when the teacher explains the material with abstract concepts.

Furthermore, the correlation between the personal level of students and the level of understanding and interest of students is calculated in each stage of learning. However, it was found that the nature of openness and agreeableness did not have a correlation with the level of students' understanding and interest. Table 2 shown

correlation between conscientiousness and student's cognitive ability and Table 3 shown Correlation between Extraversion and Neuroticism with student's affective ability.

Based on Table 2, the correlation between personality and student's cognitive ability, it is found that Conscientiousness has a significant positive correlation, even though the correlation value is included in the very low and low categories. Only at "gather information", the correlation category was moderate. In addition, based on Table 3 the correlation between personality and student's motivation, it is found that extraversion has a significant positive correlation and neuroticism has a significant negative correlation, even though the correlation value is included in the very low and low categories. But, at "gather information", the correlation was not significant.

Table 2. Correlation between Conscientiousness and student's cognitive ability

	Conscientiousness
S1	0.236*
S2	0.139*
S3	0.017
S4	0.447*
S5	0.066*
S6	0.098*
S7	0.159*
S8	0.081*

*significant

Table 3. Correlation between personalities (Extraversion Neuroticism) and student's affective ability

	Extraversion	Neuroticism
S1	0.354*	0.237* (-)
S2	0.085*	0.07* (-)
S3	0.183*	0.109* (-)
S4	0.022	0.215
S5	0.24*	0.103
S6	0.145*	0.054
S7	0.128*	0.043* (-)
S8	0.37*	0.197* (-)

*significant

Although in this study openness to experience and agreeableness did not significantly influence cognitive and affective ability, students with high openness to experience scores tended to be very active (often asked questions and expressed opinions). In addition, students whose score of agreeableness are high are more able to stick out in doing the same activities for a long time. However, further research is needed if the number of students is added and learning is carried out offline.

3.2 Modelling Proposed

Based on the results of data analysis that have been obtained, the formulation of the rate model of students' cognitive and affective abilities for each activity as follows:

1) Initial value was defined as follow:
(1) Cognitive ability = 20%,
(2) Affective = 20%,
(3) Curiosity = 20%, and
(4) Compliance Level = 80%.
2) Opening and Closing
(1) Both of Greetings and Absent increase the affective of all students

$$\% \text{ affective increasing} = t \times ke \times \left(\frac{e}{10}\right) \%$$

Where

t length of time for teacher action

ke constant multiplying the effect of extraversion on student affective

e Student's extraversion level

(2) Apperception and Generate Solution (Closing) increase students' cognitive

$$\%\ \text{cognitive increasing} = t \times kc \times \left(\frac{c}{10}\right)\%$$

Where

t duration of teacher action

kc constant multiplying the influence of Conscientiousness on student cognitive

c student's level of conscientiousness

3) Model formulation in main learning which mention in the model learning were:

$$\%\ \text{cognitive increasing} = t \times kc \times \left(\frac{c}{10}\right)\%$$

Where

t duration of teacher action

kc constant multiplying the influence of Conscientiousness on student cognitive

c student's level of conscientiousness

$$\%\ \text{increase / decrease in affective} = t \times ke \times \left(\frac{e}{10}\right)\% - t \times kn \times \left(\frac{n}{10}\right)\%$$

Where

t duration of teacher action

ke constant multiplying the influence of extraversion on student affective

e student's level of extraversion

kn constant multiplying the influence of neuroticism on student affective

n student's level of neuroticism

But, if the teacher creates some joke, the affective score does not decrease.

For stages Present the Solution and Debrief the Problem, the formula was applied if the teacher is doing the activity that should be (asking students to come forward to present the results or asking students to conclude a solution).

As a consideration for further research, the following formulations are proposed.

1) Curiosity

The level of openness of students will have a positive effect (increasing the percentage of student curiosity, with the condition of the teacher taking any action other than silence (in main activities). The rate of the increase is:

$$\%\ \text{curiosity increasing} = t \times ko \times \left(\frac{o}{10}\right)\%$$

Where

t length of time for teacher action

ko constant multiplying the effect of openness on student curiosity

o Student's openness level

When the student's curiosity has reached 100%, the student will take action to ask this to become a trigger to activate students cognitive and affective ability, the choice is:

(1) Teacher Answers student questions

$$\%\ \text{cognitive increasing} = t \times kc \times \left(\frac{c}{10}\right)\%$$

$$\%\ \text{affective increasing} = t \times ke \times \left(\frac{e}{10}\right)\%$$

(2) The teacher ignores student questions

$$\%\ \text{affective drop} = t \times kn \times \left(\frac{n}{10}\right)\%$$

2) Compliance Level

The level of students' agreeableness will have an influence on the level or percentage of student compliance (inversely proportional), with the condition of the teacher being silent (not doing activities) in main activities. The amount of reduction is:

$$\%\ \text{compliance drop} = t \times ka \times \left(\frac{a}{10}\right)\%$$

Where

t length of time for teacher action

ka constant multiplying the effect of agreeableness on student compliance

a Student's agreeableness level

When the % compliance has reached 0%, the student will take a rebellious action which becomes a trigger to deactivate cognitive ability formulation.

3.3 Model Implementation to Teaching Simulator

The Teaching Simulator developed by researchers is a simulation genre game where the user acts as a teacher who is carrying out learning activities in class. The choice of learning steps that can be taken by the teacher depends on the learning model chosen, which is Problem Based Learning. At the beginning of the game the teacher must set the time for each learning step to be carried out, with a total time of 270 seconds for one meeting as we seen in Fig. 3.

Fig. 3. Lesson plan setting in Teaching simulator

Some of the activities that can be carried out by the user depend on the learning model chosen as well, including standing / sitting, walking, asking students, answering student questions, delivering jokes, praising students, asking students to come forward / sit down (Fig. 4). The application is equipped with a number of virtual students who have different characteristics and personalities depending on the Big Five Personality scores (extraversion, agreeableness, openness, conscientiousness, and neuroticism) instilled in the students. The value of the Big Five student personality and activities carried out by the user / teacher during the simulation will have an impact on students' cognitive and affective rates, as well as points of curiosity and compliance (Fig. 5).

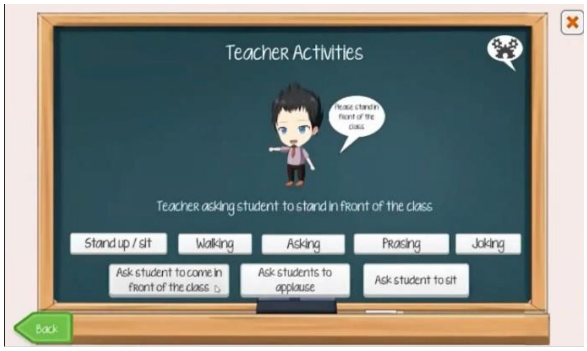

Fig. 4. Teacher Activities in Teaching simulator

Fig. 5. Student's abilities in Teaching simulator

The cognitive and affective abilities of these students will have an impact on the condition of the students during the learning simulation process. Students can be sleepy, bored, happy, and excited as ween in Fig. 6.

Fig. 6. Students condition in Teaching simulator

In the simulation scene the user can see all the activities carried out by students which are regulated by the system based on the choice of activities / learning steps chosen by the teacher (Fig. 7). Students can discuss, ask questions, come to the front of the class to present the results of the discussion, and so on.

Fig. 7. Activities in teaching simulation

If after the teacher / user does not carry out activities after choosing one (or several) steps in the learning activity, then the level of student compliance will decrease, which results in students ignoring the teacher. At the end of the simulation, the teacher will get an assessment of the results of the teaching simulation that he has done, based on the average cognitive and affective achievement of students, as well as an assessment of the activities of each learning step (according to the lesson plan).

3.4 User Experience Evaluation

We have conducted limited tests on 14 teachers, 10 pre-service teachers, 8 teacher students by using the UEQ adaptation instrument developed by Instrument [14]. Six things which are the points of our study are:

1. How the general impression of user towards the product?
2. Does the user interface look organized?
3. Is it easy to understand how to use the product?
4. Does the user feel in control of the interaction?
5. Does the user feel motivated to further use the product?
6. Does the product grab the attention of users?

The six questions used to point out: Attractiveness, Efficiency, Perspicuity, Dependability, Stimulation, and Novelty of the App.

From a scale of -3 to 3, the scores for each component based on the survey shown by Fig. 8.

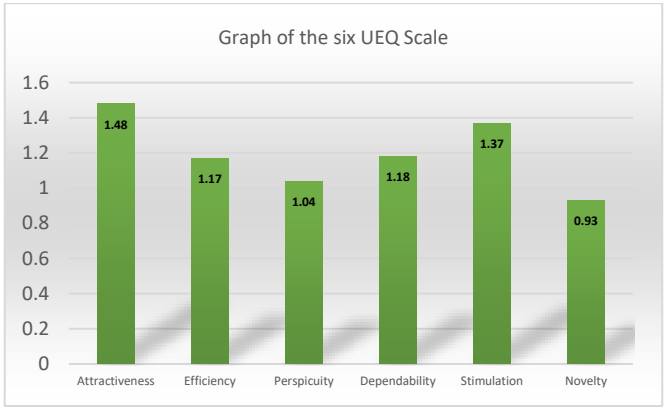

Fig. 8. Graph of the six UEQ Scale

Overall, each component gets a positive impression of the users concerning this scale. General impression of the user towards the product scores is 1.48 greater than the other points, but this application is still not enough to grab the attention of users, which is indicated by the score (i.e. 0.93) is smaller compared to other points. Likewise, there are still many users who have difficulties. Based on the result, we need some improvement on the features development and user guide section: (1) Feature: Fast, Creativity, Invention; and (2) Guide: Easy to learn, Meet expectation, Clear.

In addition, we also have recorded a score acquisition value of each user along with the recording of activity during the running of the application by performing simulations whose frequency is not much different, namely between 2 to 5 times which shown by Table 4.

Table 4. Correlation between personalities (Extraversion Neuroticism) and student's affective

	Score	Mean of Simulation time	Simulation Frequency
Teachers	82.81	4 to 5	2 to 5
Teacher students	77.4	5	2 to 5
Students	76.08	5	4 to 10

Users who are the teacher have the highest mean value. Even though the average mean simulation time (4 to 5 minutes per simulation) less than teacher students and students. Therefore, we still need to improve the application how to use this teaching simulator, so the teacher students or students will become a media to exercise and improve their teaching skill, before they become a teacher who will teach real students.

4 Conclusions

Based on this research activity, it was found that conscientiousness, was positively related to students' cognitive abilities during all learning activities, even though the category was very low and low. Extraversion was positively related to students' motivation during in almost all learning activities, even though the category was very low and low. Neuroticism was negatively related to students' motivation during in almost all learning activities, even though the category was very low and low.

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